

WHAT IS CLAIMED IS:

1. A siloxane resin composition comprising:

(A) 2.5 to 85 mole parts of  $R^1SiO_3/2$  siloxane units wherein  $R^1$  is independently selected from the group consisting of alkyl having 1 to 5 carbon atoms, hydrogen, and mixtures thereof;

(B) 2.5 to 50 mole parts of  $R^2SiO_3/2$  siloxane units wherein  $R^2$  is independently selected from the group consisting of monovalent organic groups having 6 to 30 carbon atoms and monovalent substituted organic groups having 6 to 30 carbon atoms; and

(C) 5 to 95 mole parts of  $(R^3O)_bSiO(4-b)/2$  siloxane units, wherein  $R^3$  is independently selected from the group consisting of branched alkyl groups having 3 to 30 carbon atoms and branched substituted alkyl groups having 3 to 30 carbon atoms, b is from 1 to 3, components (A), (B) and (C) combined total 100 mole parts and the sum of components (A), (B) and (C) total at least 50 percent of the siloxane units in the resin composition.

2. The siloxane resin composition as claimed in claim 1, wherein the siloxane resin contains an average of 30 to 60 mole parts component (A), 10 to 25 mole parts component (B) and 20 to 50 mole parts (C) and where components (A), (B) and (C) total 100 mole parts and the sum of (A), (B) and (C) is at least 70 percent of the total siloxane units in the resin composition.

3. The siloxane resin composition as claimed in claim 1, wherein  $R^1$  is selected from the group consisting of methyl, hydrogen and mixtures thereof,  $R^2$  is an unsubstituted or substituted alkyl group having 10 to 20 carbon atoms and  $R^3$  is a tertiary alkyl having 4 to 18 carbon atoms.

4. The siloxane resin composition as claimed in claim 1, wherein  $R^3$  is t-butyl.

5. A method for preparing the siloxane resin comprising  $R^1SiO_{3/2}$  siloxane units,  $R^2SiO_{3/2}$  siloxane units and  $(R^3O)_bSiO_{(4-b)/2}$  siloxane units, which comprises: combining

(a) 2.5 to 85 mole parts of a silane or a mixture of silanes of the formula  $R^1SiX_3$ , where each  $R^1$  is independently selected from the group consisting of alkyl having 1 to 5 carbon atoms, hydrogen and mixtures thereof, X is independently a hydrolyzable group or a hydroxy group;

(b) 2.5 to 50 mole parts of a silane or a mixture of silanes of the formula  $R^2SiX_3$ , where each  $R^2$  is independently selected from the group consisting of monovalent organic groups having 6 to 30 carbon atoms and substituted monovalent organic groups having 6 to 30 carbon atoms, X is independently a hydrolyzable group or a hydroxy group;

(c) 5 to 95 mole parts of a silane or a mixture of silanes of the formula  $(R^3O)_cSiX_{(4-c)}$ , where  $R^3$  is independently selected from the group consisting of branched alkyl groups having 3 to 30 carbon atoms and substituted branched alkyl groups having 3 to 30 carbon atoms, c is from 1 to 3 inclusive, X is independently a hydrolyzable group or a hydroxy group, silanes (a), (b) and (c) combined total 100 mole parts; and

(d) water,  
for a time and temperature sufficient to effect the formation of the siloxane resin.

6. The method as claimed in claim 5, further comprising a solvent.

7. The method as claimed in claim 5, wherein  $R^1$  is selected from the group consisting of methyl, hydrogen and mixtures thereof,  $R^2$  is an unsubstituted or substituted alkyl group having 10 to 20 carbon atoms and  $R^3$  is a tertiary alkyl having 4 to 18 carbon atoms.

8. The method as claimed in claim 5, wherein R<sup>3</sup> is t-butyl.
9. The method as claimed as in claim 5, wherein the water is present in a range from 0.5 to 2.0 moles of water per mole of X in silane (a), silane (b) and silane (c).
10. The method as claimed as in claim 5, wherein the water is present in a range from 0.8 to 1.8 moles of water per mole of X in silane (a), silane (b) and silane (c).
11. A method of forming an insoluble porous resin, which comprises:
  - (A) heating the siloxane resin of claim 1 for a time and temperature sufficient to effect curing of the siloxane resin,
  - (B) further heating the siloxane resin for a time and temperature sufficient to effect removal of the R<sup>2</sup> and R<sup>3</sup>O groups from the cured siloxane resin, thereby forming an insoluble porous resin.
12. The method as claimed in claim 11, where the heating in step (A) is from greater than 20°C to 350°C and the further heating in step (B) is from greater than 350°C to 600°C.
13. The method as claimed in claim 11, where the curing of the siloxane resin and removal of the R<sup>3</sup>O groups from the cured siloxane resin is done in a single step.
14. The method as claimed in claim 11, wherein the insoluble porous resin has a porosity from 1 to 60 volume percent and a modulus from 1.0 to 10 GPa.

15. A method of forming an insoluble porous coating on a substrate comprising the steps of

(A) coating the substrate with a coating composition comprising a siloxane resin composition having

(a) 2.5 to 85 mole parts of  $R^1SiO_{3/2}$  siloxane units wherein  $R^1$  is selected from the group consisting of alkyl having 1 to 5 carbon atoms, hydrogen, and mixtures thereof,

(b) 2.5 to 50 mole parts of  $R^2SiO_{3/2}$  siloxane units wherein  $R^2$  is selected from the group consisting of monovalent organic groups having 6 to 30 carbon atoms and monovalent substituted organic groups having 6 to 30 carbon atoms, and

(c) 5 to 95 mole parts of  $(R^3O)_bSiO_{(4-b)/2}$  siloxane units, wherein  $R^3$  is selected from the group consisting of branched alkyl groups having 3 to 30 carbon atoms and branched substituted alkyl groups having 3 to 30 carbon atoms, b is 1 to 3, components (a), (b) and (c) combined total 100 mole parts and the sum of (a), (b) and (c) is at least 50 percent of total siloxane units in the resin composition;

(B) heating the coated substrate to a temperature sufficient to effect curing of the coating composition, and

(C) further heating the coated substrate to a temperature sufficient to effect removal of the  $R^2$  and  $R^3O$  groups from the cured coating composition, thereby forming an insoluble porous coating on the substrate.

16. The method as claimed in claim 15, where the heating in step (B) is from greater than 20° to 350°C and the further heating in step (C) is from greater than 350° to 600°C.

17. The method as claimed in claim 15, where the curing and removal of the R<sup>2</sup> and R<sup>3</sup>O groups is done in a single step at a temperature within a range of greater than 20°C to 600°C.
18. The method as claimed in claim 17, where the removal of the R<sup>2</sup> and R<sup>3</sup>O groups is done at a temperature within a range of greater than 350°C to 600°C.
19. The method as claimed in claim 15, wherein the insoluble porous coating has a porosity of 1 to 60 volume percent, a dielectric constant in the range of 1.5 to 3.0 and a modulus in the range of 1.0 to 10 GPa.
20. An electronic substrate having an insoluble porous coating prepared by the method of claim 11.